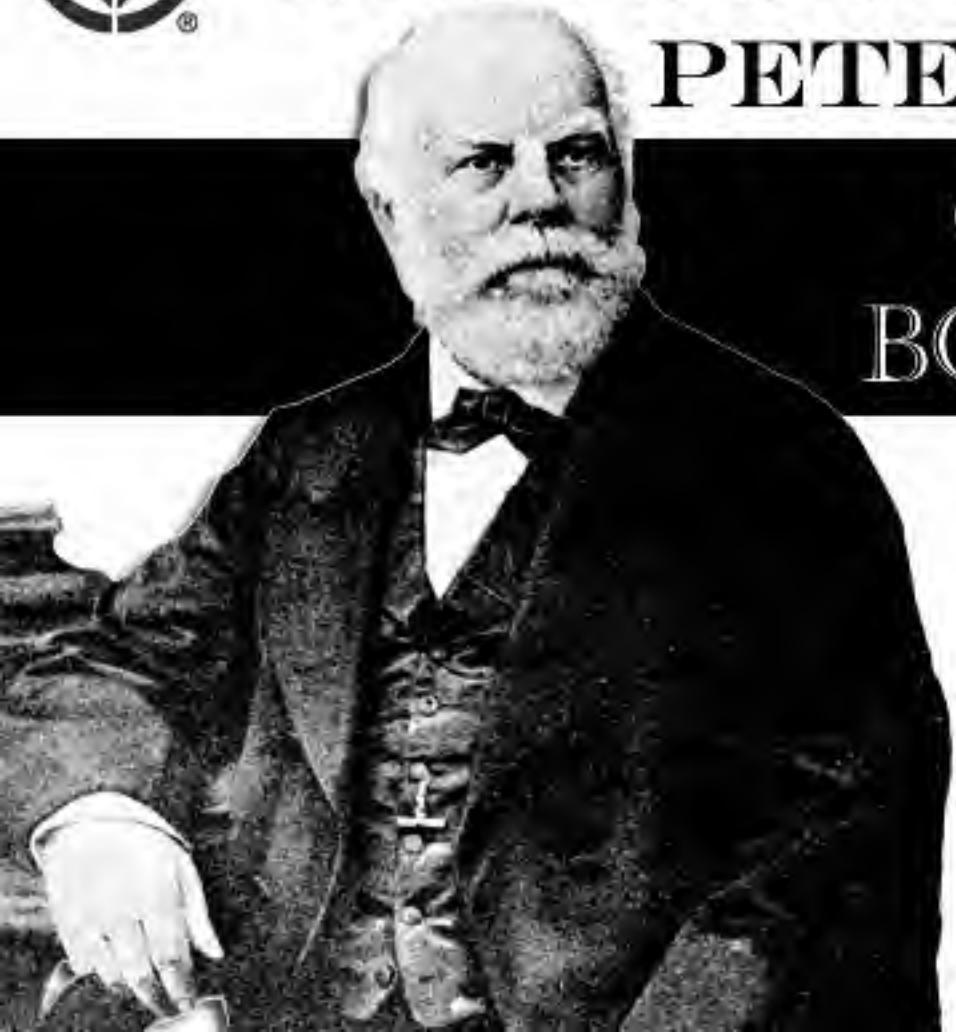




MISSOURI BOTANICAL GARDEN

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GEORGE ENGELMANN BOTANICAL NOTEBOOKS

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Coniferae collected by Ferdinand Bischoff and
Lieut. Wheeler's Expedition U. S. Engineers, 1871
Sept 15 1872

Pinus ponderosa, San Francisco Mountains; leaves all in 3" tufts
long; cone 6 inches long, rather slender, scales stout
and sharp

P. edulis Arizona, like the New Mexican plant.

Dry leaves very acute, striated, smoothedged

Cone 22 cm. long $\frac{5}{8}$, largest scales 7 broad,   rounded, with lower ones rounded
obtuse or acute, ^{obtuse or acute} knob on shoulder or angular apophysis, which shows
the transverse ridge rarely well developed, often
entirely wanting

P. monophyllus Belmont, Nevada

Cone 27 cm. long, scales $\frac{5}{8}$ - $\frac{6}{8}$ - largest



only 9 scales wide, knob prominent
knob obtuse, with lower scales rounded, on a knob
or angular very prominent apophysis, with somewhat
compressed from above, with a very prominent strongly
developed transverse ridge

P. Balfouriana var. aristata San Francisco

Mountains, exactly like the Colorado plant.
short acute cones - long acute scales

P. flexilis San Francisco Mt. like the Colorado
and still more like the New Mexican plant - ~~cone~~
6 inches long - scales triangular pointed, tips
spreading

P. flexilis var. macrocarpa "b. see notes
cone 8 inches long, scales rounded, as long as wide.

Abies Engelmanni "b. short stout leaves - much
branched, bracts stout, yellow or somewhat pubescent.
cone 2 inches long - Colorado sp. - scale protracted

A. Douglasii " Arizona - common form.

A. concolor Lind. Balfouriana Mountains
exactly like Leafer's N. Mexican sp. - no fruit



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Anatomy of Conif.

Dr. F. Thomas, zur vergl. Anatomie der
Coniferen Laubblätter.

Pringsheim, Arbeit f. wiss. Bot. IV. (1867)
p. 23-63

(Vertheilung & Bau der Spaltöffnung in Juniperi,
zur Morphologie der Coniferen Abh. Preuß. Akad. 1843

& H. DeBary. Bau der Coniferen Spaltöffnung Bot. Jg. 1860
p. 149)

p. 24. The Epicutis can not be detached from the tissues. Cells short or long,
shorter in the bands of stomata - flat or thick - Only *Pinus* & *Torreya*
p. 25 have epidermis cells thickened ^{they are thickened only outwardly} bast-like (bastatig) - in all others
p. 25 & most *Pinus* with bi-lobed leaves ^{in Torreya} the epidermis cells are
(- transverse section) ^{square or even} wider than wide - (Pinus 1: 1½ Times

1: 2 thick for all forms of this sp. is quite characteristic)
only 2 genera (*Pinus* & *Torreya*) have bast-like thickened epidermis cells - in all others only the outer cell is thickened

p. 27. The resinous ² secretion of leaves (glaucous) are peculiar
to Conifer [Taxus according to DeBary!] - but do not

occur in *Taxus* or *Podocarpus* (nearly)

p. 29. chemical tests to obtain the resin and ascertain its
"resinous" nature.

p. 30. ~~all~~ ^{the} ~~most~~ Conifers have just under the Epicutis a stratum of
empty (no chlorophyll) cells with thickened bast-like walls, - a sort
of bast cells, long extended longitudinally, roundish in cross section
~~this stratum is interrupted~~ where stomata overlay them, or often in other
places; stronger, more continuous in more robust leaves, more
interrupted in weaker ones of same branch. Most developed
on the edges and ridges - Not in *Taxus* & *Torreya*
also ^{not} in *Thuja* *Canadensis*, *Abies amabilis* *Taxodium* & *Glyptostrobus*
Somtimes this stratum of bastlike cells is several layers
thick, especially on the edges & points. In *Araucaria imbricata* ^{up to} 5 layers
of these cells
They cause the resistance of the leaves to all influences.

p. 31. Cycadace have the same strata but scarcely any other
Evergreen leaves - therefore peculiar to Gymnosperms
^{almost}
33 but some Evergreens have australopogons - *Olea* *tapei*, *Hakea*

p. 34. belong not to Epidem but Paracarp

p. 35. Thickened, often banding cells also scattered with Paracarp
of many Conifer: *Cephalotaxus*, *Podocarpus*



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p. 36 Pinophyta. The flat-leaved Conifers have usually only on the under side of the leaf the stomata — therefore the under side of the leaf parenchyma contains numerous intercellular lacunae (Gänge); the upper side of the parenchyma consists of Pallisade cells — straight not branched elongated cells, full of Chlorophyll & starch — therefore darker than the parenchyma of the lower half of leaf

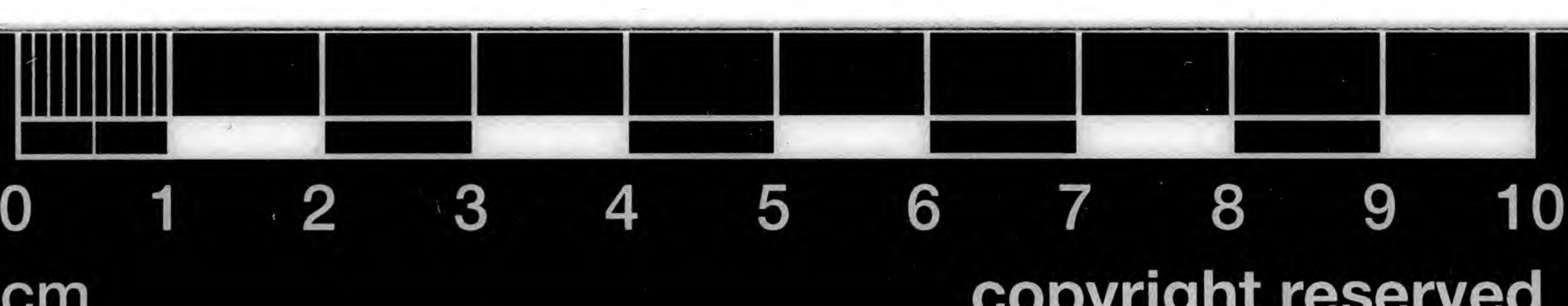
p. 38 flat leaves with stomata on both sides only in Araucaria & Podocarpus elongate [where is this concolor?] — therefore pallisade cells on both sides and between them loose tissue.

p. 39 Junipers, stomata only on upper surface — Cupressus, Bristlecone, Yew, somewhat similar — stomata mostly on upper surface

p. 40 leaves round or square show two different forms
1, Picea, Larix, Cedrus, Pinus
2, Araucaria — part, Cryptomeria, Dauricum.
The first have the bundle of vessels (Leitbündel) surrounded by a wide sheath (Schutzhülle), & the few cells have room between them & the epidermis; — intercellular dots are scarce; all walls are plicate (Pinus and Cedrus) — no pallisade cells.
The second — square-leaved Araucaria etc. have 4 strips of stomata.

p. 43. Leitbündel (Vessels) on fascioli — enclosed in the parenchyma not externally visible as nerves
They are not really vessels, Gefäßbündel, but cells of peculiar structure in two remarkably distinct layers; the upper layer are ^{ligated} wood cells, and a lower layer of like size streaked (elongated) cells of thinner walls — wood at ^{crusty} base
All these are fully developed at the end of the first season; the following years bring no change

p. 45 Only the Araucaria have a sheath (Schutzhülle) loosely surrounding the fascioli, and in it a loose cellular tissue with like (mark) cells with small dots (Tupfen)



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p. 46 A peculiar feature - Conifer is the tendency to separate in two bundles. *2* *Abies*, *Abies*, *Picea*, *Larix* *Cedrus* the bundles are separated by a single layer of cells (markstrahl) - *Pinus* sp. with 2 or 3 leaves have widely separated more distinct bundles; *Cembra*, *Strobos* and allies have only one bundle!

p. 47 *Abies balsamea*, *lanceolata* etc have the bundles divided separately and two only (like *Pines*) - the petiole.

Pinus Abies etc leaves are therefore petioles, ^{without blade} not ^{any} long

p. 48 Hary Schreber (ducts) are large intercellular ducts - ^{clothed} inside covered with thin walled epitel cells - usually one or more other larger ~~cells~~ surround these - concentric layers. Bast cells enclose them only in some sp. of *Pinus* (*sylvestris*, *Strobos*, *Brachiantha*, *Larix*) but epitel always inside.

49. Section of leaf is transparent, better than Alcohol, because don't change the Chlorophyll, does not contract the contents of cells and makes the cuts very transparent.

Resin ducts close under the wood bundles, between them and the lower epidermis - or distant from the bundles, in the paranchya or under the upper epidermis. - Their position ^{genetic?} ~~not of specific importance~~ (calicula, capsulae) ^(die Unterscheidung ist für gewisse Coniferen unerschließbar) Resin glands and resin ducts are only different forms

50. *Picea excelsa* with latent ducts, which often prevent the development of bast cells (bastarbig verdrehte Fäden)

51. *Pinus sylvestris* has two primary latent ducts and a number of accessory ones - up to 20 or 24! Different - different leaves, most in most vigorous. Some *Pinus* sp. have only the two primary ones.

52. *Abies*, *Picea*, *Larix*, *Cedrus* have two ducts.

Sequoia sempervirens has 3, 1 principal lower & 2 latent on *S. gigantea* only 1 lower one like *Cypresus*



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page 60. Origin of the ducts. Some ascribe the resin to a destructive power
others (Moore) with more probability to secretion of the living epithelium

52. No resin ducts in *Taxus*

2. One primary duct between nerve and lower Epidermis *Cupressaceae*
Sequoia, *Thuja* (excl. *Douglasii*) *Podocarpus* *Taxus* (excl. *T. balfourii*)

3. two primary ducts on both sides of leaf *Abies* *Abies* (excl. *Douglasii*)

53. *Cupressus* & *Sequoia* single lower duct - prominent or is a dark
wound just covered by Epiderm. - or ^{just under the nerve} ~~separated~~ by paranchyma from
epiderm of Cunningham *Cryptomeria*, *Pringlei*, *Alnosterobius* fibrosa

Sometimes accessory lateral border. ^{disfigures the duct is separate} ~~from the nerve by paranchyma~~

54. Form of leaf and position of ducts are in connectio, but
not always & everywhere. The ducts are typically different
in the different orders of Coniferae!

55. Abies. All have two lateral ducts, except *Thuja* var
(*Douglasii* normal, = *Abies*) *Thuja* is near *Cupressaceae*!
Douglasii is an *Abies*, therefore.

56. Abies only two lateral ducts, no accessory ones - Usually on
the lower surface, under the Epiderm; - *Abies* large one
in the paranchyma.

Picea on lower side close to Epiderm, often incomplete
or wanting; or only one. *P. jezoensis* with *Podocarpus* like
leaves has two lateral ducts = *Abies*.

57. Larix & Cedrus similar to *Picea*

Pinus great diversity - Primary leaves = *Abies*; rarely with
accessory ducts. Secondary leaves have two lateral primary
ducts in the paranchyma near to the lateral edge. *Pinus* has
usually no ducts. - Quinque leaves have often accessory ducts
in upper edge, or also on back; *halepensis* one on back
Terminate leaves have often two accessory ones, above & below
Ducts always where the Paranchyma is most
developed, thickest.

58. Araucariaceae

59. Podocarpaceae

Taxaceae *Taxus* without ducts, *Cephalotaxus* & *Taxus*
one duct between nerve & lower Epiderm



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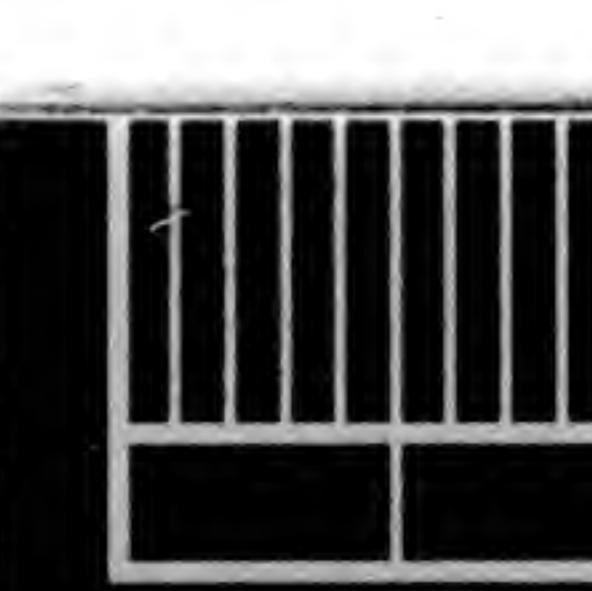


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~~lobis linear-oblongis suberectis tubo late infundibulo-
formi medio stamine paulo exserta gerente duplo longi-
oribus, style stamine superante lembo ^{sacris} arcuato; capsula
prismatica acuta.~~

On the arid hills, which overlook the sandy strand of the Pacific in the southwest corner of California, where the boundary is marked by the initial movement, ~~on the~~ ^{growing} and this fine species, ~~together with~~ Cereus Lanuginosus, was discovered by Dr Parry 1850, and a full description made: from his mem-
anda Messrs Parker and Hitchcock of San Diego rediscovered it a few months ago and supplied me with most instructive photographs and excellent specimens; last summer Dr Palmer collected it with immature fruit and in November the above named gentlemen found it in full bloom and sent fresh bunches to St Louis. This is the short history of a remarkable species, which will flourish, highly esteemed by amateurs as one of the most striking and ^{beautiful} ~~remarkable~~ Agaves and commemorative among all, who love horticulture in other climes, the name of Henry Shaw already so highly esteemed ~~as the~~ in St Louis as the founder and donor of the "Missouri Botanical Gardens", grand at present ^{and promising} & a future as magnificent as it will be useful.

The trunk of this species is short and globose or more elongated, 12-16 inches long, but all covered with its very regularly arranged ^(in $\frac{8}{13}$) broad, deep green leaves, set off by the large bright red-brown spines, forming masses of nearly 2 feet in diameter. Leaves about 8-10 inches long $3\frac{1}{2}$ - $4\frac{1}{2}$ inches wide, with a distinct brown horny margin, which bears the unusually large ^{very} close-set, flat, straight, or mostly curved upwards, or rarely



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Brogniart, Recherches sur les structures et
sur les fonctions des feuilles 1830 in
Ann. des Sciences Nat. tom 21 pl. 10

speaks also of the leaves of Coniferae

Thomas in Progessus Jahrb. IV. p. 34 says
that Boers in "Tracts on Botany" 1805 ^{according} to the state
of thickened cells (pseudo-bud) as an additional
epidermis structure - ~~transversal~~, and (as above)
Brogniart joins this view [which Th. says is
quite erroneous, as Meyer 1830 has already drawn
it] They are ~~transversal~~ ^{longitudinal} cells,
lengthened and thickened, and appear also within
the cellular paracortex.

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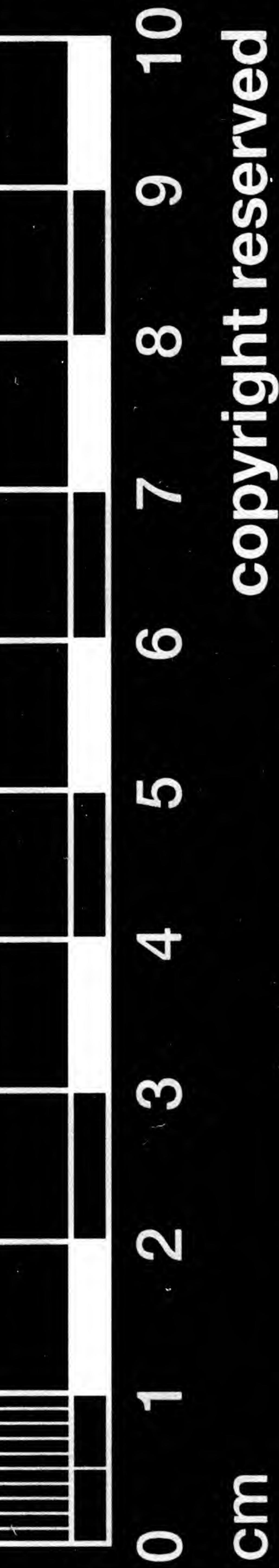
Bulletin de la Société Botanique de France tom 18. 1871

pp 376-381 Dec 8. 1871, Charles Eugène Bertrand
sur le genre *Abies*.

Attempt to class the species according to the
tomata, resiniferous ducts and pseudo liberiae
(bark) cells.

All the *Abies*, according to him, have "la nervure
bifide" etc etc. a very important work
hasty and not quite correct, ignoring, but
widely repeated by Thomas' *followed*
~~is~~ Gringsheim, 1865

(not seen *Microcaryys*, *verosparsa*, *concolor*, *canescens*)





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~~obovate, entire or often coarsely 3-dentate and
sometimes occasionally with a few teeth lower down
4-7 inches long, 2 or 3 wide; base of the leaf~~
~~or acutish; petiole 4-10 times long,~~
~~upper surface dark, shiny green, lower one pale~~
~~September not quite glabrous; sessile; the~~
~~turbinate caudex cut up about half enclosing the~~

5. *g. cinerea* - *Catesbaei* *g. sinuata*, Wall
DC. l.c. 74. It is quite probable that in the rings
by Dr. Mollichamp since several years near Bol
and not far from Walters abode, we again
Walters obscure and long ignored species. He
has also observed a similar form in South Caro
ascribed its parentage to *cinerea* and *sinuata*
as one of the parents. Dr. M. S. tree grows on rings
of *g. sinuata* *g. sinuata* *g. sinuata*
g. sinuata *g. sinuata* *g. sinuata*

Annales des Sciences naturelles, Botanique
tome XX Paris 1874

Anatomie comparée des tiges et des feuilles chez les
Gnétacées et les Conifères

5-153 tab 1-12
par M. C. L. Bertrand.

te of the Gnétacées p. 8-27.

Conifères p. 28

I. *Salicaceæ* ^{p. 28} *Phyllodoce* ³⁷ *Taxus* *Torreya* *Cephalotaxus*
Abies *Pinus* *Saxc. Gotha.*

II. *Picea* (*Picea* *Scots* *Suga*, *Tsuga*) *Larix* *Cedrus*
Abies *Pinus*

III. *Sciadopitys*

IV. *Cunninghamia* *Sequoia* *Abies* *Taxus* *Araucaria*
dammaræ

V. *Cryptomeria* *Glyptostrobus* *Taxodium* *Tif. Roya*
Cupressus *Chamaecyparis* *Biota* *Thuya* *Thujopsis*
Libocedrus *Callitris* *Achimenesstrobus*,
Widdringtonia *Bancla* *Juniperus*

(not seen *Microcachrys*, *Therosphaera*, *Orthoclinis*, *Loeckhardtia*)

Taxus, no resin ducts in leaves, but in some foreign species
cells of the pericyclic full of resin. Some species have ^{the} cells of
the lower epidermis, especially under the nerves - decentered
(mamelonné); in *T. baccata* & *Canadensis* they are smooth.

The stomas on lower side - cells between them always
elevated (knobby) except in *T. Canadensis*.

Taxus montana Nutt. is distinguishable from all other *Taxus* sp. that
the whole epidermis on the upper side is mammelonné (in
no other sp. under side epidermis under the nerve).

T. Canadensis dist. from *baccata* by the epidermis - the
stomatal bands (bandelllettes) smooth, lack (in *baccata* tubercles)
and has 6 series of stomata (baccata 13)



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Taxus globosa Schlecht. (Mex.) has a series of stomata, epiderm tabularia at the midrib below - [nothing said abt *Taxus brevifolia* Nutt for Oregon]

p. 54 *Tsuga* has a large single duct under the bundle (fascicle) no hypodermis [liber] tissue. Two inferior stomatic bands

T. myristica is a form of *T. taxifolia*

p. 55 *Cephalotaxus* a very small duct under the bundle or nerve

if *C. pedunculata* has 15-17 series stomata in each band, *C. fortunei* 21 or more

p. 57 *Podocarpus* under each bundle a duct.

69. *Saxe-Gothaea* same as *Podocarpus*

70. *Picea Linnae Cedrus Abies, Pinus*

77 The primary bundle [nerve] is undivided in *Tsuga*, *Pseudotsuga* & *Abies*; divided in two in *Abies*; *Picea x Cedrus* is intermediate slightly divided, or not divided. - Bundles surrounded by a sheath of cuboid short cells, which do appear towards the base of the leaf - with cells within the sheath small, punctate (tissue areole)

79 *Pineae*: Section *Abies* & *Cembra* has only a single undivided bundle with areolate tissue within the sheath (short cuboid cells) Porous hymen of large cells, no palisade-cells 3 ducts close to the hypoderm near the 3 angles.

80 *Pseudotsuga* also 3 ducts corresponding with the 3 angles of the leaf, but close to the sheath; - bundles single

Abies & *Picea* has divided bundles, in one sheath

81 *Monophylle* [a separate section?] one large central bundle

82 All *Pinus*: have stomates in rows, not ^{gathered} in bands

83 *Picea* Link with 3 subgenera, *Picea* *Pseudotsuga*, *Tsuga*.

Picea proper - bundle ^{usually} single, or divided - no palisade parenchys

Mostly 2 ducts ^{close to} ^{but see last page} ^{but more on upper than lower} ^{the epiderm of lower side} ^{Stomates on both sides} ^{side}
~~see last page~~ ^{from Van Couver!} ^{P. sitchensis has! both flat leaved} ^{and} ^{not}

84 Only *P. Abies* has none on the lower side - No *Picea* has below stomatic bands (= *Kotulaea*)

85 *Pseudotsuga* (*P. nobilis* (!!) *Davidiana*^{n.sp.}, *gigantea*, *Douglasii*)
palisade cells, 2 ducts near the edges on lower epidermis
stomates below, - bands. *Nobilis* & *Davidiana* have stomata also



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on upper surface, with 2 bands, ^{above} ~~below~~ ^{above} ~~below~~ ^{stom.} ~~stom.~~ ~~in the grove~~
Tsuga ~~has no stomata above~~ ^{5 rows} of the ~~in each band below~~
~~and no hypodermis on upper surface~~

p. 87. *Tsuga* single nerve and under it a single duct, large, ^{light, after fibrous edges of leaf}
palisade cells. 2 bands of stomata on lower surface, none
on upper (*T. Hookeriana* has also stomata on upper surface)
Hypodermis tissue in *T. Canadensis* ^(granular) and leaf edges with
elevated cells; *T. S. Sieboldii* ^(= *Thunbergii*) edge smooth, hypodermis;
T. Breuana. edge smooth, no hypodermis. ^{Martensiana = Canadensis}
^{in the anatomy}

p. 89 *T. Larix* palisade cells present, nerve single, very small ducts
at edge of leaf between the hypodermis & epidermis cells.
Two small bands of stomata below; in *Sylvaticus* & *Americanus*
also stomata above

p. 91. *Cedrus* 3 species single bundles with large median
midrib ray. No palisade cells. Stomata in 2 or 3
stripes on upper surface, and 1-3 on each side of lower face
Two ducts on lower surface near edge, close to epidermis
C. Atlantica no stomata below; *C. Libani* 4 series of stomata
above, 2 below. *C. Deodara* 8-12 above 4-6 below
p. 92 *Abies* - divided nerve, two ducts - 2 bands of stomata below, rarely
any above
ducts on lower epidermis or in parichnos. - palisade tissue
Stomata on upper surface only in *A. grandis* from ^{to Mexico, Texas & Balsamier} California & *A. Regalis* Andes

ducts *A. grandis*, *Regalis*, *Numidica*, *Cephalonica*, *pestrinaria*, *Pedunculata*
below in ducts *spatulata*, *Gordoniiana*
ducts (in *Obliqua*, *Fasciculata*, *Balsamea*, *Vestita*, *Sibirica*,
parichnos *Koreolepis*, *Forma*)

p. 94 *A. grandis*, *lasiocarpa*, *Concolor* are synonyms. Calif.

p. 95 *A. spatulata* *Herpin de Fremont*. Calif.

A. Gordoniiana Van Couwen isle.



p. 95 (note), *A. religiosa* anatomically same as *Bracteata*

A. amabilis (probably 10 rows of stomata on upper epiderm) *Fraseri*

Table. p. 93: *A. grandis* all upper side with stomata, 16 rows = each lower band in all species

A. Bracteata no stomata above, more than 10 rows = each lower band

no false bid cells, continuous band (zone) of hypoderm

A. spicata same but leaves broad and more

A. Gordoniana similar, but interrupted zone of hypoderm

A. Fraseri has hypoderm and 2 series of stomata on upper

A. bilineata no hypoderm,

96 *Pinus* ^{sect.} *Cembra* Strob. *Pseudostrob.* *Feei* *Pinea* *P. monophylla*

97 *Strob. Lambertiana* has stomata below,

Strob. exelsa not! St. has 2, exelsa 3 ducts

98 *Pseudostrob.* 3 leaves! Only *Portoricensis* seen 3 leaves

undivided nerve, 3 ducts ^{close} to sheath! correspond to 3

Feei 3 leaves, nerve divided; *P. Feei* has no ducts

ponderosa 4 ducts with paracyt. *Cassia* ^{length of} *strob.* *longifolia*

& *insularis* have only 2 ducts close to hypoderm, *C. pendulina* 1

on the edge, long fil. on upper, *insularis* on lower ^{cells}

99 *Pinus* anatomically = *Feei*

Pinaster 2 leaves nerve divided, no ducts in *P. contorta* ^{paracyt.}

100 no ducts in middle of upper side *mbra* ducts close to hypoderm

" " " *pungens* 3 ducts, not close to hypoderm

" " " *Pinaster* also *pyrenaica* & *lemoniana* 2 or 5 ducts

one duct in middle of upper side *silvestris* *pruriens* *tarasio* ^{not on hy.} *halepensis* ^{caerulea}, *Salzmanni*

brutia & *Massoniana*.

102 *Monophylla* ~~no leaves~~ but a brushlet (11) cylindric

2 ducts! close to hypoderm

103 *Sericea* leaves single! *Eyde* is quoted as earliest

than Muhl; the reverse is true;

110 *Cunninghamia* *Sequoia* & *aristotelys*.



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114. Sequoia - stomata on upper surface, in series, in two groups on lower surface in two bands; in S. sempervirens 3 ducts,

2 close on lower epiderm; in S. gigantea only one duct, below lower band

115. Araucaria in all (except A. Cunninghamii) several nerves without sheath - parichysis with ducts

127. Taxodium 2 bands of stomata below, usually several series above duct between nerve and lower hypoderm.

133. Cypress as Chamaecyparis Brots, Thuya, Thujopsis, Lycopodium, Peltis, Adelostoma, Widgystoma, Bacille, Juniperus. very little said about them. Neither genera nor species can be characterized anatomically

140. The anatomical differences between the genera of Conifers [Gymnosperm]
are much more considerable than between the genera
of other phanerogams [Angiosperms]

15. The length of the wood cells is very variable in same species. Parenchyma fundamental (cellular parichysis) large cells, the membranes of which are wrinkled & doubled - often part of the cells are palisade ^{cells}. The parichysis cells often change into hypodermis fibres

No bands of stomata in Piney, but in Abies, Tsuga & Scandixpoma



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p. 84 *Picea* flat leaves without stomata on lower side (*P. ajanus*) or with stom. below (*P. sibirica*)
square leaves without ducts, 4 series of stom above 2 below *P. nigra*
10 — — ab 6 bl *P. alba*
with 1 duct *P. excelsa*
with 2 ducts 8 series of stom ab 6 bl *P. Kestrow*
12 — — 10 — *P. polonica*

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Note sur Abies, par Ch. E. Bertrand

The species of Abies (Link) with petiolated leaves have no stomata on the upper surface, leaves distichous, base (or petiole) turned so that the stomat-bearing lower surface is always inferior.

Species with flat leaves are distinguished from Abies with petiolated leaves, the former (e.g. *A. Ajacis*) bear the stomata on the upper surface, Abies (e.g. *A. Nordmanniana*) on the lower surface; the former turn the leaves of the lower surface of the branch always to bring the stomata toward the above.

Then Abies without petioles bear the stomata on the upper surface, and each leaf is paged below on the branch.

stomata in white series, or bands

Two resiniferous channels ^{toward} on the lower surface of leaf, surrounded by [bast] vessels also resin bearing or secreting, are close to the epidermis, or separated from it by stomata of 3 pair of cells. — Known as "Bifide"

Species one channel, under the midrib, stomata of 2 pair of cells, "nervous single"

Species known single — two channels, marginal and under the epidermis — or none. — Stomata always on the upper, sometimes also on lower surface. — stomata of 3 pair of cells

2 groups of Abies :

1, resiniferous channels ~~closer to~~ epidermis

a stomata ~~only~~ on upper surface

A. grandis 14 rows above, 10 on each side below

A. Regalis Amabilis 14 " 7 " "

var A. Baborensis

A. numidica 9-15 stomata at the upper end of opposite of leaf



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6. no stomata on opp side
A. Willmottiae 7 stomata on each side below
A. Redowii " "
A. Cephalonica " "
A. apollinis in variety " "
A. Nordmanniana " "
A. pestinaria is a variety " "

A. Colchica
A. Ciliata more than 10 rows of stomata on each side
A. Crinita " "
A. Gordoniana (from Van Couver)
 2, resiniferous channels not close to epidermis
 a. stomata on opp surface
A. Phoenopepla 12 rows above
A. Frasera 6 " "
A. Balsamea ^{A. umbellata} 2-3 rows above

 b. no stomata on upper side
A. nephrolepis 7 rows on each side below
A. sibirica " " "
A. firma more than 7 rows " "
A. Vertebrata

Synopsis:

Stomata above, more than 8 rows *grandis* Reg. Andre
 6 rows *Phoenopepla*
 2 rows *Frasera*
 small cluster of stom. at tip *balsamea*
 no stomata above, more than 7 rows on each side below *Crinita*, *Gordoniana*
 7 rows on each side *Nordmanniana*,
Ciliata, *Vertebrata*



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Jal. Sacks, Lehrbuch 4th ed. 1874 p. 107

Cork cells cover and protect wounded parts - in larger masses they form the bark, after the appearance of the epidermis, and even before it is destroyed, under it, the cork cells are completely ^{thickened} persistent cells and phellogen cells, then a living, dividing and making more cork and phellogen - The Phellogen layer is mostly inside of the Cork tissue - The continuous cork covering is periderm. In older trunks the periderm is replaced by "Bark ("Boke")" Cell masses or expansions which permeate the different tissues of the bark are changed into Cork - Cambium, which after producing Cork lamellae dies out - These Cork Cambiae separate scaly etc pieces from the bark, the outside dries up, the cork Cambiae penetrate deeper and deeper into the growing bark tissue, and thicker strata of bark are separated from the living parts

Lenticelle are cork tissue fungi - Frankelot's and the epidermis after kills the epidermis bands and the lenticelle become off prominent warts, the ground - the middle. Lenticelle (Wager) only on places of the epidermis. New stoma are found.



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~~T. pubescens, Lam. (Red Ash.)~~

Tree of middle size: branchlets of the season and petioles velvety-pubescent; inner face of their outer bark red or cinnamon-color when fresh: leaflets 7 to 9; oblong- or ovate-lanceolate, gradually acuminate, mostly ~~entire~~ entire (3 to 5 inches long), bright green above, pale and more or less pubescent or tomentose beneath: fruit as in the preceding but usually longer (1½ to 2 inches), sometimes ^{much} shorter and the wing ~~abbreviated~~ (truncated),



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Zuccarini, zur Morphologie der Coniferen (Abth. 1 Bayr.
Akad. 1843) — especially on Stomata

Hildebrand, Bau der Coniferen Spaltöffnungen
Bot. Zeit. 1860. p. 139 &c.



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copy of the *Geological Survey of the West and its Territories, by M. S. G. Engelmann, in-charge of the Second Division No. 2* of the *Geological Survey of the United States*, by M. L. Moulton, Geologist in charge of the Survey of the Territories.



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leaf of *Conifer* marinated in
Chlorate of Potassa with Nitro
acid to
to study the epidermis &
stomata.



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Iquawka Ills.,

Dr. Geo. Engelmann. Oct. 14, 1875.

Dear Sir,

65. 30

Many thanks for determination



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Annual rings ~~woolly~~
A L Child in Popular Science
monthly Dec 1882 & Dec 1883
But Gazette Jan 1884.

Often more, sometimes less, than the age
of the tree !!
apparently sensational nonsense



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omskrivn: Förra den 'Bray' in varefas
fin in store mängd.

Iff gaba gnu drifit fökkring
dovit fin mift glänta iif förra min
Böck mift fallan vällan

Fryabank
Ed. Langen

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Thomas, anatomische Untersuchung
der Coniferen Blätter

Pringsheim's Jahrb. IV. p. 27

slag, wax —

coated layers of wax granules in
the glaucous Conifers

wax principally on the stone-cells — they
& escape — more than on other cells of
the epidermis

Geo. Engelmann M.D.



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Sir:

The regular meetings of the Academy
of Science, take place every first and third
Monday of each month.

Your punctual attendance is requested at



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